S
621.31245
N7eam
1982

[redacted]

[redacted]

STATE DOCUMENTS COLLECTION

MAR 1 2 2001

MONTANA STATE LIBRARY
1515 E. 6th AVE.
HELENA, MONTANA 59620

ENGINEERING ASSESSMENT
MHD RETROFIT STUDY

MILESTONE #1

DETERMINATION OF PLANT TO BE USED FOR RETROFIT

MOUNTAIN STATES ENERGY INCORPORATED
POST OFFICE BOX 3767
BUTTE, MONTANA 59701

MONTANA STATE LIBRARY
3 0864 0015 6871 9

[redacted]

ENGINEERING ASSESSMENT
MHD RETROFIT STUDY

MILESTONE #1

DETERMINATION OF PLANT TO BE USED FOR RETROFIT

WIN 96-04 '81

Mountain States Energy Inc.
POST OFFICE BOX 3662
BUTTE, MONTANA 59702
(406) 723-8182

82CDIF-143

December 16, 1982

Mr. Robert J. Robinson
Deputy Director
Dept. of Natural Resources and Conversation
32 South Ewing
Helena, MT. 59601

Subject: Engineering Assessment - MHD Retrofit Study

Reference: Agreement Between DNRC and Mountain States Energy, Inc.,
November 1, 1982

Dear Mr. Robinson:

Submitted herewith are the results of Milestone #1, "Determination of Plant to be Used for Retrofit", of the Engineering Assessment concerning the MHD retrofit potential for an advanced test system.

The power plant which has been selected for the study is the J. E. Corette Plant in Billings, Montana.

The effort to complete Milestone #1 is summarized on Attachment #9 which constitutes an invoice for activities through December 10, 1982. Attachments 2 through 8 provide the detail for Attachment #1. Work on Milestone #2 "Specification of Baseline Configuration" was initiated on December 13, 1982 and will continue unless directed otherwise.

If you have any questions or additional information or clarification are required, please let me know.

Sincerely,

J. M. Sherick
Vice President
Mountain States Energy, Inc.

JMS:dlk

Attachments:

1. Summary of Activities of DNRC Milestone 1.
2. Letter of Approval from EEI Task Force on MHD.
3. Trip Report from J. M. Sherick to F. C. Fogarty on EEI MHD Task Force Meeting.
4. Letter to All Utilities, Soliciting Utility Participation in the Study.
5. Mailing List of Utilities.

6. Letter to Members of EEI Task Force.
7. Mailing List of EEI Task Force.
8. Trip Report from E. Ashby to J. M. Sherick on Denver Meeting with EEI MHD Task Force Representatives.
9. Invoice for Milestone #1.
10. Cost Estimate for Milestone #2.
11. Milestone Schedule and Status Report.

Attachment 1

Summary of DNRC Milestone 1 Activities

The objectives of Milestone 1 were twofold:

a. Obtain utility involvement in the MHD Advanced Test Train System.

b. Select a Montana power plant which is suitable for being retrofitted with the MHD Advanced Test Train, and which is also representative of other retrofit candidates.

As was specified in the referenced document, there were 5 points to be specifically addressed in this milestone. These are discussed below.

1. Develop Retrofit Criteria

We have relied on the criteria which were developed in the DNRC-MPC Phase I Study and in addition have imposed requirements that the owning utility must meet for a retrofit design to be feasible and that it be representative of other plants which the utility industry might consider for retrofit. In this connection it should be noted that of the seven candidates submitted to us for consideration, only two were rated at less than 70 MW net electric power output. The five largest plants also shared the common feature of turbine reheat, which may be an important consideration in the design of a Heat Recovery unit for the MHD generation system. For this reason, an additional requirement was imposed that the selected plant must be rated at 100 MW net power output or greater.

Digitized by the Internet Archive
in 2015

https://archive.org/details/engineeringasses1982moun

2. Solicit Base Information on Montana Plants

This task was accomplished by the letter (Attachment 4), which was sent to both utilities (Montana Power Company and Montana-Dakotas Utilities) which have steam generation facilities in the state of Montana.

3. Solicit EEI Task Force Participation

This was accomplished through the two meetings which were held with members of the EEI Task Force (Attachments 3 and 8), and through the letter (Attachment 6) which invited the EEI Task Force to act in an advisory and review capacity during the study. We have obtained excellent cooperation from both the EEI Task Force and the Electric Power Research Institute during this initial phase of the study, and their comments and criticism have been most helpful in guiding the selection of the retrofit candidate.

4. Solicit Non-Montana Utility Input on Typical Available Plants

This has been accomplished by the letter (Attachment 4) which invited some 213 utilities to submit candidate power plants which they would consider retrofitting with the Advanced Test System. Of the seven candidates submitted, four were located outside the state of Montana, and all of these were rated at 100 MW_e or greater.

5. Categorize and Summarize Data

The data which was obtained is summarized on the following page. Of the seven plants submitted only the J. E. Corette plant meets all of the requirements stated above. The complete data which we received is on file and is available on request. The data indicate that electric utilities are primarily interested in retrofitting plants which have a power output of at least 100 MW_e, and we have adopted this as a working assumption. An additional point to be noted is that the Corette plant is already coal-fired, and this fact simplified the problem of designing coal-handling facilities for the MHD power train.

In conclusion, we believe that the J. E. Corette plant meets all of the requirements which a good retrofit candidate should have, and that the study which is based on it will have the widest possible application to the utility industry.

Name of Plant	Lewis & Clark	Frank Bird	J. E. Corette	Sheldon Unit #2	Canaday	Geo. Neal Unit #1	D. H. Mitchell, #11
Location	Sidney, MT	Billings, MT	Billings, MT	Hallam, NE	Lexington, NE	Sioux City, IA	Gary, Ind.
Utility Company	MDU	MPC	MPC	NPPD	CNPP & ID	Iowa Pub. Svc. Co.	No. Ind. P. S. C.
Power Output, MW_e (net, max)	51	66	163	123	96	132	110
Fuel	Lignite	#2 Fuel Oil	Rosebud Coal	Sub-bit. Coal	#6 Fuel Oil	Coal or Nat. Gas	Coal
Thermal Input, (10^8 BTU/Hr.)	5.75	7.71	16.34	12.5	9.00	12.5	11.07
Plant Heat Rate, BTU/KW-Hr.	11270	11840	9843	10160	9375	9470	10075
Overall Efficiency, pct	30.3	28.8	34.8	33.6	34.6	36.0	33.9
Turbine:							
Number of Stages	16	20	22	20	23	21	--
Feedwater Heaters	5	4	6	5	5	6	5
Turbine Reheat	NO	NO	YES	YES	YES	YES	YES
Inlet Steam Flow, lbm/hr	475,000	590,000	1.23×10^6	830,000	651,000	948,600	783,000
Inlet Steam Pressure, psia	1264	863	1903	1864	1814	1815	1815
Inlet Steam Temperature, deg. F	950	900	1000	1000	1000	1000	1000
Inlet Steam Enthalpy, BTU/lbm	1468	1453	1478	1479	1480	1480	1480

DATA SUMMARY OF RETROFIT CANDIDATES

Attachment 2

The undersigned members of the EEI MHD Task Force have reviewed the following candidate plants submitted for consideration as an MHD retrofit Advanced Test System.

1.	Sheldon Station	109 MW_e	Nebraska Public Power District
2.	J. E. Corette	160 MW_e	Montana Power Company
3.	Frank Bird	60 MW_e	Montana Power Company
4.	Canady Plant	100 MW_e	Central Nebraska Public Power and Irrigation District
5.	Lewis and Clark Station	50 MW_e	Montana-Dakota Utilities
6.	George Neal Station Unit #1	139 MW_e	Iowa Public Service Co.

These plants all basically comply with the criteria imposed for candidate submittal. Consequently any of these plants could ultimately serve as a valid Advanced Test System. However, the larger of these plants, which are the majority, have steam conditions, reheat, etc., more nearly consistent with presently projected Heat-Seed Recovery Systems. Therefore, an Advanced Test System developed around these type plants would be more directly scaleable to the first-generation commercial MHD plant.

Although we believe any of the Montana plants would provide the basis for a valid representation of the submitted candidates, we believe the essential features of these candidates are best represented by the Montana Power Company's J. E. Corette plant in Billings, Montana.

We therefore concur with Mountain States Energy's recommendation that the J. E. Corette plant be chosen for the Engineering Assessment of an MHD retrofit to serve as an Advanced Test System.

Clinton P. Ashworth
Pacific Gas and Electric Co.

Al Dolbec
Electric Power Research Institute

Fred E. Walter
Fred E. Walter
Montana Power Co.

Robert L. Bolger
Commonwealth Edison Co.

Attachment 3

Mountain States Energy Inc.
POST OFFICE BOX 3767
BUTTE, MONTANA 59701
(406) 494-7100
FTS 587-7100

3

Date: October 29, 1982

To: F. C. Fogarty

Thru:

Copies: G. Staats, V. DeJong, R. Carrington, J. Bosworth, M. Covington, E. Ashby

From: J. M. Sherick JM Sherick

Subject: Trip report - Edison Electric Institutes MHD Task Force Meeting

The subject two day meeting was attended in Palo Alto, California on October 27th and 28th, 1982. The meeting agenda is attached (Attachment I). Attending the meeting were about twenty five task force members and topic presenters (See attachment II). As can be seen from the topics covered, the meeting constituted a pretty comprehensive review of the current MHD program.

I presented the State of Montana Phase II program (Attachment III) and obtained a favorable vote from the Task Force to support that project.

Attachment IV is a copy of the EPRI presentation which reflects our current understanding of the EPRI program plus a new task to assess the current development status (see final slide of EPRI presentation). Also Attachment V is a copy of the TRW coal combustor status presentation.

Besides the formal meetings I was able to take part in many informal conversations with the meeting participants. These conversations ranging from formulating a recovery plan for the 1A1 Channel with Stan Petty to expanded EPRI involvement with Al Dolbec were very worth while and productive.

JMS/ab

ATTACHMENT V IS IN THE CENTRAL FILES

[illegible]
ID
SS
[illegible]
IA
DA

Attachment I

Gilbert/Commonwealth engineers and consultants

GILBERT ASSOCIATES, INC., P. O. Box 1498, Reading, PA 19603; Tel. 215-775-2600; Cable Gilasoc/Telex 836-431

FINAL AGENDA

EEI MHD TASK FORCE

October 27, 28 1982

Palo Alto, CA

Wednesday, October 27

8:30 a.m.	Registration and Coffee	
9:00 a.m.	Introductory Remarks	Dr. Heinz Pfeiffer (PP&L)
9:15 a.m.	The National MHD Program - DOE Perspective and Impact of Administrative Changes	Mr. George Rudins (DOE-Hq) Mr. Dwight Shelor (DOE-Hq) Dr. Sun Chun (PETC) Dr. Ralph Carabetta (PETC)
10:45 a.m.	The MHD Industrial Forum	Mr. Dave Brown
11:00 a.m.	The EPRI MHD Program	Mr. Al Dolbec (EPRI)
11:15 a.m.	Role of the EEI Task Force	Mr. Mike Trykoski (EEI)
11:30 a.m. - 1:00 p.m.	Lunch	
1:00 p.m.	Results of the Montana Program on MHD Demo Plants	Dr. Fred Walter (MPC)
1:30 p.m.	Tour of the Stanford University Combustion and MHD Labs	Dr. Charles Kruger

Thursday, October 28

9:00 a.m.	Status of MHD Combustor Development	Mr. Marty Bauer (TRW)
	Status of MHD Generator Development	Mr. Stan Petty (AVCO)
	Status of HRSR	Dr. Susan Wu (UTSI)
	Combustor Systems and the Status of the Closed Cycle MHD Program	Dr. Bert Zauderer (Coal Tech)
	Status of MHD Retrofit Studies	Mr. Jim Criswold (SCE)
11:30 a.m.- 1:00 p.m.	Lunch	
1:00 p.m.	Task Force Committee Meeting and Election of Officers	Dr. Heinz Pfeiffer (PP&L)
4:00 p.m.	Adjournment	

Attachment II

MEETING ATTENDEES

Heinz Pfeiffer (PP&L)
Jim Moyer (SCE)
Jim Griswold (SCE)
Robert Albrecht (Consumers Power)
Tom McGrath (Puget Sound P&L)
Clint Ashworth (PG&E)
Jack Gibbons, (Philadelphia Electric)
Fred Walter (MPC)
Al Dolbec (EPRI)
Leanard Angello (EPRI)
Mike Trykoski (EEI)
George Rudins (DOE-HQ)
Dwight Shelor (DOE-HQ)
Sun Chun (PETC)
Jim Lacey (PETC)
Dave Brown (FORUM)
Charles Kruger (Stanford)
Kent Koester (Stanford)
Marty Bauer (TRW)
Stan Petty (AVCO)
Susan Wu (UTSI)
Bert Zauderer (Coal Tech.)
Bill Owens (GAI)
John Cutting (GAI)
Joe Bosworth (MSE)
Jack Sherick (MSE)
Jack Groves (New Mexico)

Attachment III

EDISON ELECTRIC INSTITUTE

MHD TASK FORCE

PRESENTATION

OCTOBER 27, 1982

PRESENTATION OUTLINE

- STATE OF MONTANA EFFORT
- PHASE II TASKS
- SCHEDULE AND PARTICIPANTS

STATE OF MONTANA
EFFORT

- HB-908
- PHASE I
- PHASE II

PHASE II - SCOPE

USE PHASE I REQUIREMENTS FOR THE DEVELOPMENT OF A UTILITY-AGREED-TO ENGINEERING ASSESSMENT OF AN ADVANCED TEST SYSTEM UTILIZING AN MHD RETROFIT TO AN EXISTING CONVENTIONAL GENERATING FACILITY

PHASE II PROJECT TASKS

1. PLANT SELECTION AND SYSTEM REQUIREMENTS

2. DESIGN REQUIREMENT DEVELOPMENT

3. REPORTING AND REVIEW

TASK 1

PLANT SELECTION AND SYSTEM REQUIREMENTS

- DEVELOP CRITERIA FOR CANDIDATE PLANTS
- SOLICIT CANDIDATE PLANTS FROM UTILITIES
- SELECT A CANDIDATE PLANT
- DEFINE RETROFIT CONCEPT/CONFIGURATION
- PERFORM CONFIGURATION ANALYSIS

TASK 2

DEVELOP DESIGN REQUIREMENTS

- INTERFACE
- FUNCTIONAL
- OPERATIONAL
- SITING
- ENVIRONMENTAL
- SOCIOECONOMIC
- COST AND SCHEDULE ESTIMATES

TASK 3

REPORTING AND REVIEW REQUIREMENTS

- MILESTONE STATUS REPORTING
- TECHNICAL REVIEWS
  - CONSULTANTS
  - EEI TASK FORCE
  - PARTICIPATING UTILITIES
  - DNRC

PROJECT SCHEDULE

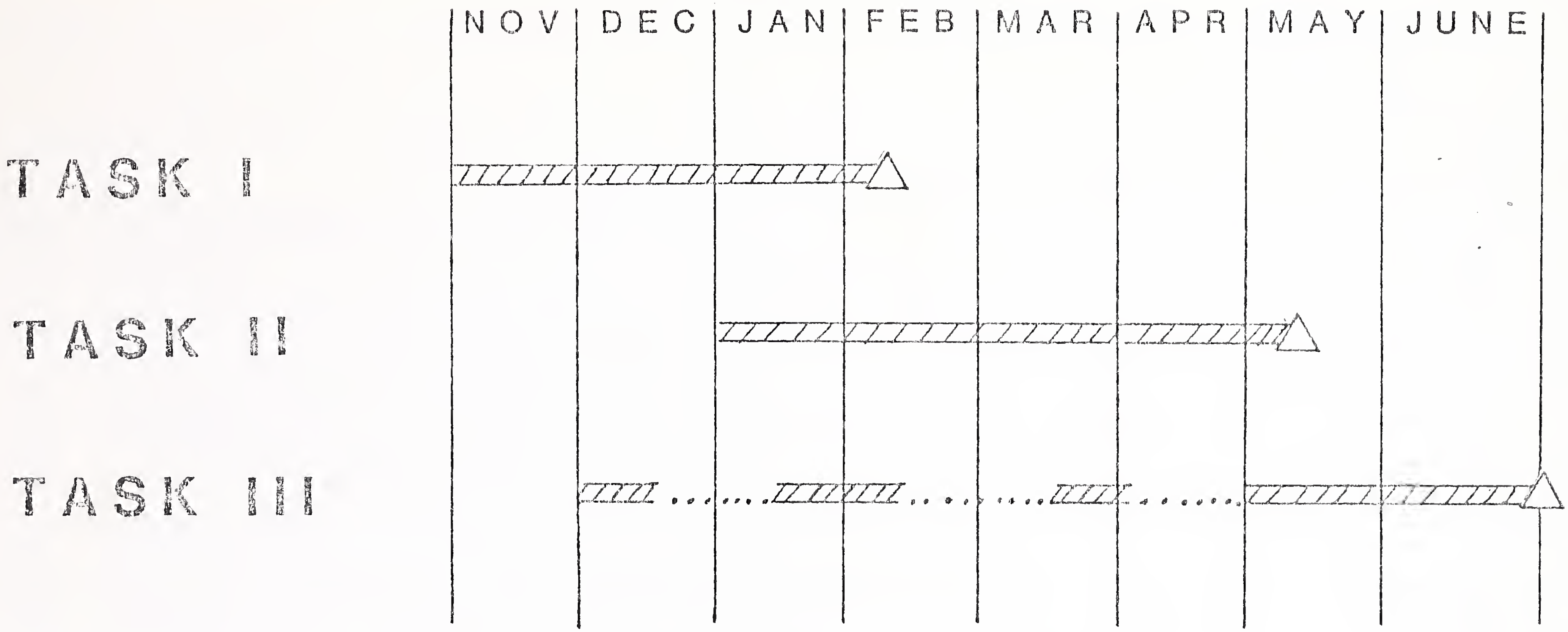


EXHIBIT B

PAGE OF

MILESTONE SCHEDULE AND STATUS REPORT

1. Contract Identification Department of Natural Resources and Conservation

2. Reporting Period through

3. Contract Number

4. Contractor (name, address)
Mountain States Energy, Inc.
P. O. Box 3767
Butte, MT 59702

5. Contract Start Date

6. Contract Completion Date

7. Identification Number	8. Reporting Category (e.g. contract line item or work breakdown structure element)	9. 1982 OCT	NOV	DEC	1983 JAN	FEB	MAR	APR	MAY	JUN	10. Percent Complete a) Planned	b) Actual
DNRA	DETERMINATION OF PLANT TO BE USED FOR RETROFIT	—	—	▼								
DNRB	SPECIFICATION OF BASELINE CONFIGURATION			—	▼							
DNRC	CONFIGURATION ANALYSIS				—	▼						
DNRD	DETERMINE DESIGN REQUTS					—	▼					
DNRE	FINALIZATION OF DESIGN REQUIREMENTS						—	▼				
DNRF	COST AND SCHEDULE ESTIMATES							—	▼			
DNRG	IMPACT ON NATIONAL AND DEVELOPMENT PROGRAM							—	▼			
DNRH	DRAFT ENGINEERING ASSESSMENT								—	▼		
DNRI	FINALIZE ENGINEERING ASSESSMENT									▼		

11. Remarks

12. Signature of Contractor's Project Manager and Date

PHASE II- KEY PARTICIPANTS

PROJECT MANAGER -

E.W. (GENE) ASHBY, MSE

ENGINEERING STAFFS - MSE, MULTITECH

CONSULTANTS - FINN HALS
DICK ROSA
STEWART WAY
GILBERT AND ASSOCIATES
UTSI
BABCOCK AND WILCOX

UTILITIES - EEI TASK FORCE
MONTANA POWER CO.
OTHERS

PHASE II RESULT

ESTABLISHES CRITERIA FOR A MINIMUM SIZED ADVANCED SYSTEM WHICH HAS UTILITY CONCURRENCE AND ACCOMPLISHES WHAT WAS PREVIOUSLY ENVISIONED FOR THE ETF.

MHD

- Study Design of 1st Generation
  - Cost Competitive
  - Efficiency Reasonably
  - Configuration
- Develop Electrical Interface to System
  - Channel equivalent Circuit
  - Inverter Design
  - Test $\underbrace{\text{3500 kW}}_{\text{Capability}}$ Inverter

Practical MHD plant & arrival of high temperature combined cycle should be at about the same time

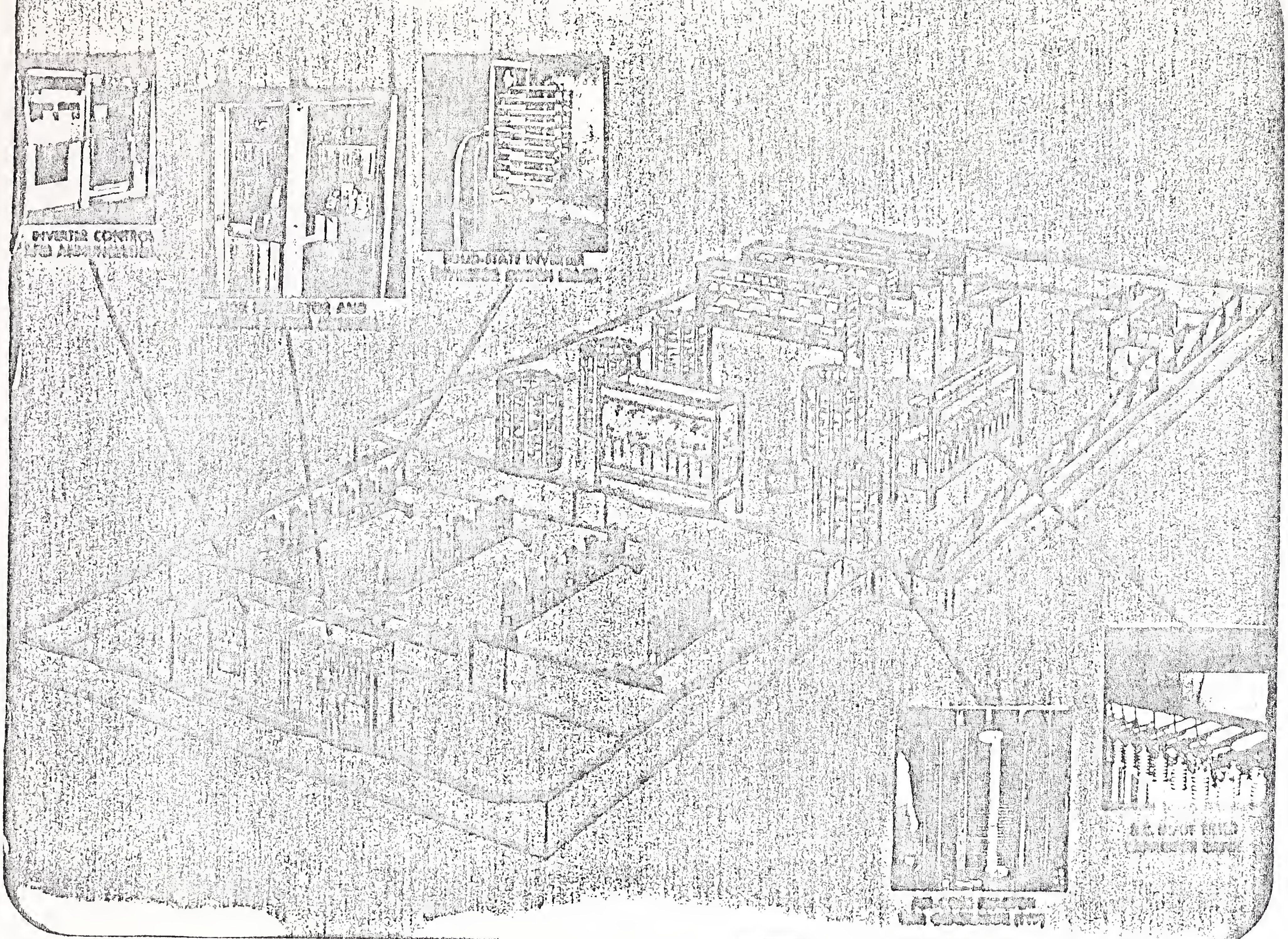
Spill-over in knowledge to other technologies

Ferraro is winning his bet w/ fuel cell inverter development.

ACD
5/81

EPRI

MHD INVERTER SYSTEM FOR



EPRI

FUTURE MHD ACTIVITIES

OBJECTIVE: TO PRODUCE A CONSOLIDATION CIRCUIT DESIGN AND EVALUATE IT AT THE CDIF

PAY-OFF: ENHANCED CHANNEL LIFE AND EFFICIENCY OVER CURRENT STATE-OF-THE-ART MAGNETIC CONSOLIDATION SCHEMES

Really looking for innovation. State of the art development.

APPROACH: THREE COMPONENT EFFORT

- STANFORD UNIVERSITY EFFORT TO PLAN TEST SUPPORT AND ANALYSIS
- MOUNTAIN STATES ENERGY EFFORT TO OPERATE CDIF EXPERIMENTS AND GATHER DATA

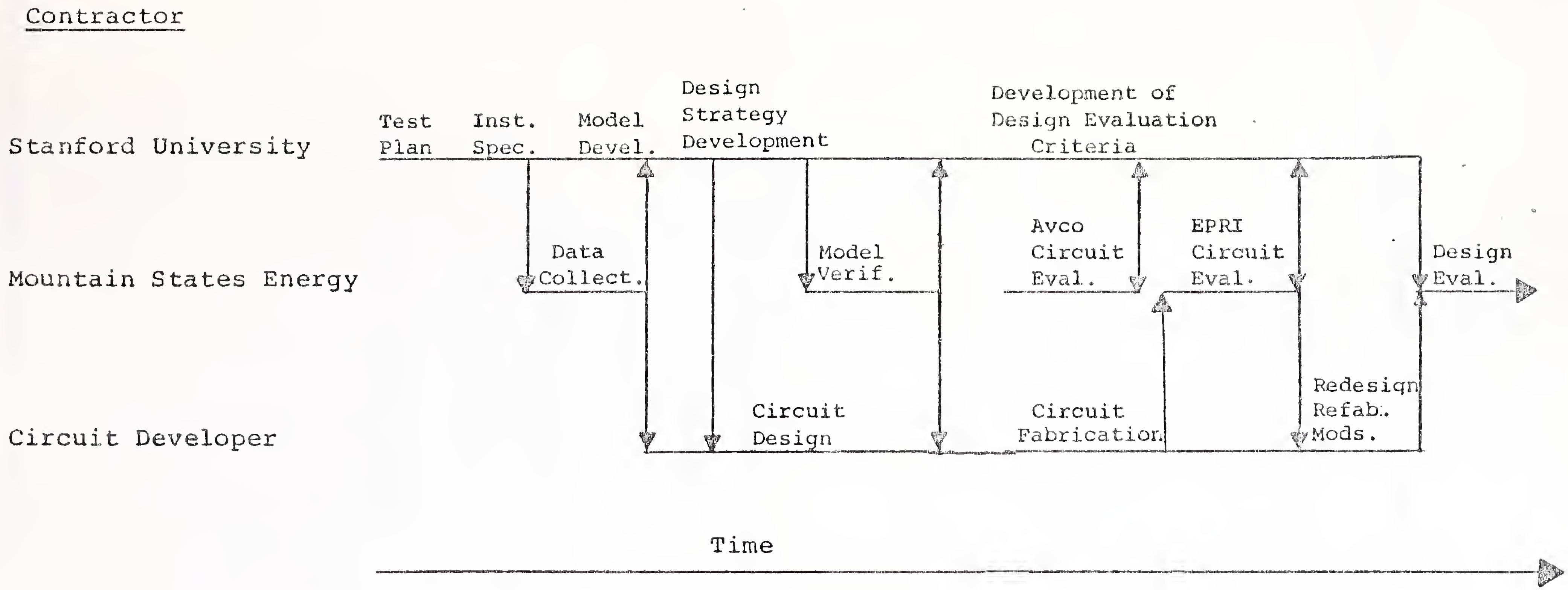
Special Instrumentation

- CIRCUIT DEVELOPER TO DESIGN AND FABRICATE AN ADVANCED CONSOLIDATION CIRCUIT SCHEME

Again innovation is key.

EPRI

MHD Milestone Schedule



ASSESSING TECHNOLOGY

(COMMERCIALIZATION)

New technique: new to be used in technology assessment MHD would be one of first looked at.

DEFINE PRODUCTS NEEDED

- SC MAGNET
- CHANNEL

Radiant Heat Boilers

ETC.

Recruit a REVIEW BOARD FOR EACH PRODUCT

- EXPERIENCE 30 yr type
- RESPONSIBLE CHARGE of Engr. Grp.

Retired people w/ no company affiliation.

Al would like input

PRESENT STATUS OF EACH PRODUCT

- QUESTIONS ANSWERED

REVIEW BOARD OUTPUT

- TECHNICAL PROBLEMS listing. What type of experiments necessary
- TIME TO SOLVE
- COST TO SOLVE

ROM Based on their best judgment only

- RESOURCES TO SOLVE

MARKET/INVESTMENT INSIGHTS

EPRI can identify possible markets in 2000+ ..

ACD
10/26/82

EPRI

Mountain States Energy Inc.
POST OFFICE BOX 3662
BUTTE, MONTANA 59702
(406) 723-8182

Letter to: All Utilities

Dear Sir:

The purpose of this letter is threefold -- first to update you on an exciting developing technology, magnetohydrodynamics (MHD) and to provide an update of current status; second to inform you of an Engineering Assessment being performed to retrofit an MHD system to an existing power plant; and third to offer your company the opportunity of participating in this Engineering Assessment.

4

Magnetohydrodynamics is a technology which has a high potential of enhancing the operating efficiency of baseload power stations by as much as 50%, and at the same time providing environmentally acceptable effluents. A description of the technology is included in Attachment I.

Progress in the development of MHD has been significant. Attachment II outlines this progress and the current status of the technology. Mountain States Energy, Inc. is currently undertaking a project funded by the State of Montana, Department of Natural Resources and Conservation (DNRC) to perform an Engineering Assessment for a retrofit of an Advanced Test System (ATS). This is a follow-on activity to a DNRC funded Phase I program which established the overall ATS performance requirements from a utility perspective. The Engineering Assessment (Phase II) will utilize these performance requirements to develop a system configuration, scoping cost and schedule for an ATS retrofit to an existing power plant. From this configuration, recommendations for the National MHD development program will be structured and the scale-up risks assessed and categorized. The overall objective of Phase II is to provide a utility concurred Engineering Assessment and recommendation to the National MHD program for an MHD retrofit.

The first major task of the Phase II project will be to select an existing power plant to be used as the basis for the project. In order to make this selection the intent is to solicit candidate plants from all utilities and to categorize these plant into comparable ranges. The plants considered to be most acceptable will be matched to the most representative existing Montana power plant which will be used as the basis of the Engineering Assessment. The power plant is to meet the following criteria:

A. 60 to 150 MWe class.
B. Currently coal-fired or willing to consider a changeover to coal.
C. Remaining design life of greater than 10 years or can reasonably be upgraded to this.
D. Site compatible for expansion.
E. Capacity usable.
F. Available for a 3-9 month shutdown for final tie-on.
G. Load demand compatible with intermittent operation of MHD portion during the first operating year, followed by approximately 60%-70% plant availability for remainder of life.

To assure a Utility Industry representative plant is selected for this study, Mountain States Energy, Inc. requests your participation in this program as follows:

1. Review your system in relation to the above criteria and select a system plant(s) you feel would make a good generic candidate for MHD retrofit as an Advanced Test System, that best meets the criteria.
2. Submit engineering data, (Attachment III).

Members of the Edison Electric Institute (EEI) Task Force on MHD have agreed to evaluate all the retrofit candidates submitted to determine which plant could best serve as the ATS they will then compare this plant to the available Montana plants and select the plant which best meets the utility needs.

The EEI would then recommend to MSE which Montana plant would be most appropriate for the Engineering Assessment based upon the aggregate utility industry input.

The performance and completion of the Phase II project will greatly enhance the National MHD program and it's future direction and your company could benefit substantially by direct involvement in the project. Therefore, it is hoped that you can be counted on to support this project. Please provide the information requested on Attachment III for a candidate plant and return it to MSE by November 22, 1982. Any questions, comments, or recommendations are solicited and should be referred to the undersigned.

Your support of this project is greatly appreciated.

Respectfully,

J.M. Sherick
Vice President

Attachment III

MHD RETROFIT STUDY

PLANT INFORMATION

PLANT PERFORMANCE DATA REQUESTED FOR A CANDIDATE RETROFIT PLANT

1. Name and location of candidate plant.
2. Type of plant - coal-fired or oil-fired.
3. Thermal input (B.T.U.).
4. Mass flow rate of coal or oil.
5. Electrical output (MWe).
6. Description of turbine(s):
   - o Number of stages.
   - o Inlet steam conditions with valves wide open (mass flow rate, pressure, temperature, enthalpy).
   - o Exhaust conditions.
   - o Description of regenerative feedwater heaters, if any.
7. Name and phone number of knowledgeable engineer who could supply additional engineering data.

____ No, we cannot participate in the Engineering Assessment Project

because ____

____

____

____

Addressee ____

Company ____

Address ____

Attachment 5

	RESPONSE/DATED	PARTICIPATION	NON-PARTICIPATI
ALABAMA			
Alabama Electric Cooperative, Inc. P.O. Box 550 Andalusia, Alabama 36420 Gen. Mgr. - C. R. Lowman			
Alabama Power Co. 600 North 18th St. Birmingham, Alabama 35291 Pres. - J. M. Farley	12-6-82		X
Tennessee Valley Authority Alabama District 501 First Federal Bldg. Muscle Shoals, Alabama 35660 Dist. Mgr. - W. D. Thompson			
ALASKA			
Golden Valley Electric Assn, Inc. P.O. Box 1249 Fairbanks, Alaska 99707 Gen. Mgr. - R. L. Hufman			
ARIZONA			
Arizona Electric Power Cooperative, Inc. P.O. Box 670 Benson, Arizona 85602 Gen. Mgr. - J. B. Flanders			
Arizona Public Service Company 411 North Central Ave. P.O. Box 21666 Phoenix, Arizona 85036 Chmn, Board, Pres & Ch Exec Ofcr - K. L. Turley			

5

	RESPONSE/DATED	PARTIC.	NON-PARTI(
Salt River Project Agricultural Improvement & Power District 1521 Project Drive P.O. Box 1980 Tempe, Arizona 85001 Pres - K. F. Abel			
Tuscon Electric Power Company 220 W. Sixth St. Tucson, Arizona 85702 Chmn, Board - J. L. Davis			

ARKANSAS

	RESPONSE/DATED	PARTIC.	NON-PARTI(
Arkansas Electric Cooperative Corp. 8000 Scott - Hamilton Drive P.O. Box 9469 Little Rock, Arkansas 72219 Gen Mgr - C. S. Whillock			
Arkansas Power & Light Co. P.O. Box 551 Little Rock, Arkansas 72203 Pres & Ch Exec Ofcr - Jerry L. Maulden	11-22-82		X

CALIFORNIA

	RESPONSE/DATED	PARTIC.	NON-PARTI(
Burbank Public Service Dept. 164 W. Magnolia Blvd. Burbank, CA. 91503 Gen Mgr - R. O. Snyder			
Glendale Public Service Department 119 N. Glendale Ave. Glendale, CA. 91206 Gen Mgr - Wm. H. Fell			
EPRI 3412 Hillview Ave. P.O. Box 10412 Palo Alto, CA. 94303 Richard Balzhiser - V.P.	12-10-82	X	

	RESPONSE/DATED	PARTICIPATION	NON-PARTICIPATI
Imperial Irrigation District 333 E. Main St. Imperial, CA. 92251 Gen Mgr - D. Twogood			
Los Angeles Dept of Water & Power 111 N. Hope Box 111 Los Angeles, CA. 90012 Gen Mgr - L. H. Winnard			
Pacific Gas & Electric Co. 77 Beale St. San Francisco, CA 94106 Chmn, Board & Ch Exec Ofcer - F. W. Mielke, Jr.			
Pasadena Water & Power Dept 100 N. Garfield Ave., Room 301 Pasadena, CA. 91109 Gen Mgr - K. A. Johnson			
San Diego Gas & Electric Co. 101 Ash St. San Diego, CA. 92101 Pres & Ch Exec Ofcr - R. E. Morris			
Southern California Edison Co. P.O. Box 800 Rosemead, CA. 91770 Chmn, Board - W. R. Gould			
COLORADO			
Colorado Springs Dept of Public Utilities 18 S. Nevada Ave., Box 1103 Colorado Springs, CO. 80947 Dir - J. D. Phillips	12-1-82		X

	RESPONSE/DATED	PARTICIPATION	NON-PARTICIPATION
Colorado UTE Electric Assn. Inc. P.O. Box 1149 Montrose, CO. 81401 Pres - J. J. Bugas			
Public Service Co. of Colorado 550 15th Street Denver, CO. 80202 Pres & Ch Exec Ofcr - R. F. Walker			
CONNECTICUT			
Connecticut Light & Power Co. P.O. Box 2010 Hartford, Conn. 06101 Chmn, Board & Ch Exec Ofcr - L. F. Sillin, Jr.			X
Hartford Electric Light Co. P.O. Box 2370 Hartford, Conn. 06101 Chmn, & Ch Exec Ofcr - L. F. Sillin, Jr.	11- [illegible]		X
United Illuminating Co. 80 Temple St. New Haven, Conn. 06506 Chmn, Board & Ch Exec Ofcr - J. D. Fasset			
DELAWARE			
Delmarva Power & Light Co. 800 King St. P.O. Box 231 Wilmington, Delaware 19899 Chmn, Board & Ch Exec Ofcr - R. D. Weimer			
Dover Munic Power Plant P.O. Box 475 Dover, Delaware 19901 Mgr, Elec Opr - R. Schuaker			

	RESPONSE/DATED	PARTICIPATION	NON-PARTICIPATIC
DISTRICT OF COLUMBIA			
Potamac Electric Power Co. Thomas Edison Bldg., 1900 Pennsylvania Ave., N.W., Washington, D. C. 20068 Chmn, Board & Pres - W. Reid Thompson	12-1-82		X
FLORIDA			
Florida Power & Light Co. P.O. Box 529100 Miami, Florida 33152 Chmn, Board & Ch Exec Ofcr			
Florida Power Corp. 3201 34th St, S., P.O. Box 14042 St. Petersburg, Florida 33733 Pres & Ch Exec Ofcr - A. H. Hines, Jr.			
Ft. Pierce Utilities Authority 206 S. 6th St. P.O. Box 3191 Fort Pierce, Florida 33450 Dir, Util - E. Menge			
Gainesville Regional Utilities 200 E. University Ave. P.O. Box 490 Gainesville, Florida 32602 City Mgr - Orville Powell			
Gulf Power Co. 75 N. Pace Blvd. Box 1151 Pensacola, Florida 32520 Pres & Ch Exec Ofcr - E. L. Addison			

	RESPONSE/DATED	PARTICIPATION	NON-PARTICIPATION
Jacksonville Electric Authority 233 W. Duval Box 53015 Jacksonville, Florida 32202 Chmn - W. L. Williams, Jr.			
Lakeland Dept of Electric & Water Utilities P.O. Box 368 Lakeland, Florida 33802 Dir - W. R. Lesnett			
Orlando Utilities Commission 500 S. Orange Ave. Box 3193 Orlando, Florida 32802 Exec VP & Gen Mgr - C. H. Stanton			
Tallahassee Elec Dept 2602 Jackson Bluff Road Tallahassee, Florida 32304 Dir - K. W. Morgan			
Tampa Electric Company 702 N. Tampa St. P.O. Box 111 Tampa, Florida 33601 Pres & Ch Exec Ofcr - H. L. Culbreath	11-15-82		X
Vero Beach Municipal Utilities P.O. Box 1389 Vero Beach, Florida 32960 Dir, Util - J. V. Little			
GEORGIA			
Georgia Power Co. 333 Piedmont Ave. Atlanta, Georgia 30308 Pres & Ch Exec Ofcr - R. W. Scherer			

	RESPONSE/DATED	PARTICIPATION	NON-PARTICIPATIC
Savannah Electric & Power Co. 600 Bay St. E, Savannah, Georgia 31402 Chmn, Board & Ch Exec Ofcr - J. M. McIntosh			
HAWAII			
Hawaiian Electric Co. Inc. 900 Richards At. Honolulu, Hawaii 96813 Pres & Ch Exec Ofcr - C. D. Pratt Jr.	11-23-82		X
IDAHO			
Idaho Power Co. 1220 Idaho St. P.O. Box 70 Boise, Idaho 83707 Chmn, Board & Ch Exec Ofcr - J. E. Bruce			
ILLINOIS			
Central Illinois Light Co. 300 Liberty Street Peoria, Illinois 61602 Pres & Ch Exec Ofcr - H. D. Feltenstein, Jr.	11-19-82		X
Central Illinois Public Service 607 East Adams Stl Springfield, Illinois 62701 Pres & Ch Exec Ofcr - D. G. Raymer			
Commonwealth Edison Co. One First National Plaza P.O. Box 767 Chicago, Illinois 60690 Chmn, Board & Pres. - J. J. O'Connor			

	RESPONSE/DATED	PARTICIPATION	NON-PARTICIPATION
Electric Energy, Inc. P.O. Box 165 Joppa, Illinois 62953 Pres - G. A. Rice			
Illinois Power Co. 500 South 27th St. Decatur, Illinois 62525 Chmn, Board & Pres - Wendall J. Kelley			
Southern Illinois Power Cooperative Box 255, Route 4 Marion, Illinois 62959 Exec VP & Gen Mgr - L. T. Clevenger			
Springfield Water Light & Power Dept. 201 Municipal Bldg. Springfield, Illinois 62757 Supt, Opr - L. Gladish			
INDIANA			
Hoosier Energy Rural Electric Coop Inc. P.O. Box 908 Bloomington, Indiana 47402 Exec VP & Gen Mgr - Virgil E. Peterson			
Indianapolis Power & Light Co. 25 Monument Circle P.O. Box 1595-B Indianapolis, Indiana 46206 Chmn, Board & Ch Exec Ofcr - Zane G. Todd			
Northern Indiana Public Service Co. 5265 Hohman Ave. Hammond, Indiana 46320 Chmn/Pres, Ch Exec Ofcr - E.A. Schroer	12-6-82	X	

RESPONSE/DATED PARTICPATION NON-PARTICIPATI

Public Service Co. of Indiana, Inc.
1000 East Main Street
Plainfield, Indiana 46168

Chmn, Board & Ch Exec Ofcr - H.A. Barker

Richmond Power & Light
2000 U.S. 27 South
P.O. Box 908
Richmond, Indiana 47374

General Manager-I.A. Huffman

Southern Indiana Gas & Electric Co.
20-24 N.W. Fourth Street
Evansville, Indiana 47741

Chmn, Board & Ch Exec Ofcr - D.W. Vaughn

Indiana-Kentucky Electric Corp
P.O. Box 468
Piketon, Ohio 45661

Indiana & Michigan Electric Co.
2101 Spy Run Ave.
Fort Wayne, Indiana 46801

Chmn, Board & Ch Exec Ofcr - W.S. White, Jr.

IOWA

Iowa Electric Light & Power Co.
ie: Tower, 200 First St, SE
Cedar Rapids, Iowa 52401

Chmn, Board & Pres - D. Arnold

Iowa-Illinois Gas and Electric Co.
206 E. Second St.
Davenport, Iowa 52808

Chmn, Board & Pres-D.R. Stichnoth

	RESPONSE/DATED	PARTICIPATION	NON-PARTICIPATION
Iowa Power and Light Co. 666 Grand Ave. Box 567 Des Moines, Iowa 50303 Chmn, Board & Ch Exec Ofcr - D.H. Swanson			
Iowa Public Service Co. 401 Douglas Street Box 778 Sioux City, Iowa 51102 Chmn/Pres, Ch Exec Ofcr - F.W. Griffith	11-22-82	X	
Muscatine Power & Water 3205 Cedar Street Muscatine, Iowa 52761 General Manager-C.L. Bowen			
KANSAS			
Western Power Division Central Telephone & Utilities Corp. (Kansas Division) Broadway at Morton Great Bend, Kansas 67530 Division Manager-J.P. Wendel			
Kansas City Board of Public Utilities 700 Minnesota Ave. Kansas City, Kansas 66101 Acting Manager, Prod & Dist-M.C. Heuer			
Kansas Gas and Electric Co. 201 N. Market Street Wichita, Kansas 67201 Pres & Ch Exec Ofcer-W. Cadman			
Kansas Power & Light Co. 818 Kansas Ave. Topeka, Kansas 66612 Chmn Board Pres & Ch Exec Ofcr-W.E. Wall			

	RESPONSE/DATED	PARTICIPATION	NON-PARTICIPATIC
Sunflower Electric Cooperatiye Inc. P.O. Box 980 Hays, Kansas 67601 General Manager-A.J. Schnose			
KENTUCKY			
Big Rivers Electric Copr. 201 Third Street P.O. Box 24 Henderson, KY 42420 General Manager-W.H. Thorpe			
East Kentucky Power Cooperative Inc. Box 707, Route 60 Winchester, KY 40391 Pres & General Manager-D.R. Norris	12-1-82		X
Kentucky Utilities Co. One Quality Street Lexington, KY 40507 Chmn, Board Pres & Ch Exec Ofcr - W.B. Bechanan			
Louisville Gas and Electric Co. P.O. Box 32010 311 W. Chestnut Street Louisville, KY 40232 President-R.L. Royer			
Owensboro Municipal Utilities 115 East 4th Street Owensboro, KY 42301 General Manager-J.P. Pace			
Tennessee Valley Authority Box 1088 Hopkinsville, KY 42240 District Manager-J.C. Hall			

RESPONSE/DATED PARTICIPATION NON-PARTICIPATI

LOUISIANA

Alexandria Munic Power & Light Dept.
1011 N. Third
P.O. Box 71
Alexandria, LA 713101

Dir, Utilities - R.L. Lawrence

Cajun Elect Power Cooperative Inc.
P.O. Box 578
New Roads, LA 70760

Exec Vice Pres & General Manager-J.R. Smith

Central Louisiana Electric Co Inc.
415 Main Street
Pineville, LA 71360

Chmn, Board & Ch Exec Ofcr-G.L. Galloway

Gulf States Utilities Co.
446 North Blvd.
Baton Rouge, LA 70802

Div, VP- J.E. Moss

Lafayette Utilities System
Box 4017-C
1830 Walker Road
Lafayette, LA 70502

Dir, Utilities-R.P. Hehert

Louisiana Power and Light Co.
142 Delaronde St.
New Orleans, LA. 70174

Pres & Ch Exec Ofcr - J. M. Wyatt

New Orleans Public Service Inc.
317 Barronne St.
New Orleans, LA. 70160

Pres - James M. Cain

	RESPONSE/DATED	PARTICIPATION	NON-PARTICIPATION
Southwestern Electric Power Co. 428 Travis St. P.O. Box 21106 Shreveport, LA. 71156 Pres - J. L. Stall	12-1-82		X
MAINE			
Central Maine Power Co. Edison Drive Augusta, Maine 04336 Pres & Ch Exec Ofcr - E. W. Thurlow			
MARYLAND			
Baltimore Gas & Electric Co. P.O. Box 1475 Baltimore, MD 21203 Chmn, Board - B. C. Trueschler			
Delmarva Power and Light Co. Southern Division US 13 & Naylor - Mill Road Salisbury, MD 21801 Mgr - M. F. Horner			
MASSACHUSETTS			
Boston Edison Company 800 Boylston St. Boston, Massachusetts 02199 Chmn, Board & Ch Exec Ofcr - T. J. Galligan, Jr.			
New England Power Co. 25 Research Drive Westborough, Massachusetts 01581 Chmn - G. W. Nichols			

	RESPONSE/DATED	PARTICIPATION	NON-PARTICIPATION
Western Massachusetts Electric Co. 174 Brush Hill Ave. West Springfield, Massachusetts 01089 Chmn, Board & Ch Exec Ofcr - L. F. Sillin, Jr.	11 [illegible]		X
Montaup Electric Co. P.O. Box 391 Fall River, Massachusetts 02722 Pres - J. F. G. Eichorn			
MICHIGAN			
Consumers Power Co. 212 W. Michigan Ave. Jackson, Michigan 49201 Chmn, Board, Pres & Ch Exec Ofcr - J. D. Selby			
Detroit Public Lighting Dept. 9449 Grinnell Ave. Detroit, Michigan 48213 Head Elec Eng - J. Remski			
Detroit Edison Co. 2000 Second Ave. Detroit, Michigan 48226 Chmn, Board & Ch Exec Ofcr - W. J. McCarthy Jr.	11-15-82		X
Lansing Board of Water and Light 123 W. Ottawa Box 13007 Lansing, Michigan 48901 Dir, Util - E. F. Brush	12-6-82		X
Upper Penninsula Power Co. 616 Shelden Ave. Houghton, Michigan 49931 Chmn, Board, Pres & Ch Exec Ofcr - C. F. Rogers			

	RESPONSE/DATED	PARTICIPATION	NON-PARTICIPATION
MINNESOTA			
Minnesota Power and Light Co. 30 W. Superior St. Duluth, Minnesota 55802 Chmn, Board, Pres & Ch Exec Ofcr - J. F. Rowe	11-16-82		X
Northern States Power Co. 414 Nicollet Mall Minneapolis, Minnesota 55401 Chmn, Board & Ch Exec Ofcr - D. W. McCarthy			
Otter Tail Power Co. 215 S. Cascade Fergus Falls, Minnesota 56537 Pres - R. M. Bigwood			
MISSISSIPPI			
Mississippi Power & Light Co. Electric Bldg. Jackson, Mississippi 39205 Pres - D. C. Lutken			
Mississippi Power Co. 2992 W. Beach Gulfport, Mississippi 39501 Chmn, Board & Ch Exec Ofcr - V. J. Daniel Jr.	12-1-82		X
South Mississippi Elec Power Assn P.O. Box 1589 Hattiesburg, Mississippi 39401 Gen Mgr - G. B. Taylor			

MISSOURI

	RESPONSE/DATED	PARTICIPATION	NON-PARTICIPATION
Associated Electric Cooperative, Inc. M P.O. Box 754 Springfield, Missouri 65801 Gen Mgr - G. F. Diddle			
Independence Power & Light Co. Dept. 21500 E. Truman Rd Independence, Missouri 64056 Elec Util Dir - P. F. Banks			
Kansas City Power & Light Co. 1330 Baltimore Ave. Kansas City, Missouri 64105 Chmn, Board Pres & Ch Exec Ofcr - A. J. Doyle			
Missouri Public Service Co. 10700 East 350 Highway Kansas City, MO 64138 Pre & Gen Mgr - Richard C. Green			
Springfield City Utilities 301 E. Central JS Box 551 Springfield, MO 65801 Gen Mgr - J. L. McMahan	11-15-82		X
Union Electric Company 1901 Gratiot St. St. Louis, Missouri 63103 Chmn, Board & Ch Exec Ofcr - Charles J. Dougherty			

	RESPONSE/DATED	PARTICIPATION	NON-PARTICIPATION
MONTANA			
Montana Power Co. 40 E. Broadway Butte, Montana 59701 Chmn, Board & Ch Exec Ofcr - J. A. McElwain	12-2-82	X	
NEBRASKA			
Central Nebr. Power and Irrig. Dist. Boxt 356 Holdrege, Nebraska 68949 Pres - C. J. Hargleroad	11-22-82	X	
Nebraska Public Power District P.O. Box 499 Columbus Nebraska 69601 Board Pres - G. H. Barber	12-1-82	X	
Omaha Public Power District 1623 Harney St. Omaha, Nebraska 68102 Pres, Board Dir - F. J. Hogan	12-1-82		X
NEVADA			
Nevada Power Co. 4th St. & Stewart Ave. Box 230 Las Vegas,Nevada 89151 Chmn, Board - Arthur E. Pearson			
Sierra Pacific Power Co. 100 E. Moana Lane Box 10100 Reno, Nevada 89510 Chmn, Board Pres & Ch Exec Ofcr - J. L. Gremban	12-6-82		X

RESPONSE/DATED PARTICIPATION NON-PARTICIPAT

NEW HAMPSHIRE

Public Service Co. of New Hampshire
1000 Elm St.
P.O. Box 330
Manchester, NH 03105

Chrm, Board & Ch Exec Ofcr - William C. Tallman

NEW JERSEY

Atlantic City Electric Co.
1600 Pacific Ave.
Atlantic City, New Jersey 08404

Pres & Ch Exec Ofcr - J. D. Freeman

Jersey Central Power and Light Co.
Madison Ave. at Punch Bowl Rd.
Morristown, New Jersey 07960

Chmn, Board & Ch Exec Ofcr - R. I. Smith 12-3-82 X
Public Service Electric & Gas Co.
80 Park Plaza, Newark, N.J. 07101
(R. I. Smith)

NEW MEXICO

Public Service Co. of New Mexico 11-22-82 X
Alvarado Square
Albequerque, New Mexico 87158

Chmn, Board - G. A. Schreiber
[illegible]

El Paso Electric Co.
P.O. Box 910
Las Cruces, New Mexico 88001

Mgr, Div Eng/Dist - G. L. White

Southwestern Electric Co-op Inc.
P.O. Box 369
Clayton, New Mexico 88415

Mgr, Supt & Pur Agt - D E. Carter

	RESPONSE/DATED	PARTICIPATION	NON-PARTICIPATI
NEW YORK			
Central Hudson Gas & Electric Corp. 284 South Ave. Poughkeepsie, New York 12602 Chmn, Bord & Princ Ofcr - T. J. Carlson			
Consolidated Edison Co. of N. Y., Inc. 4 Irving Place New York, New York 10003 Chmn, Board, & Ch Exec Ofcr - Charles F. Luce	12-3-82		X
Long Island Lighting Co. 250 Old Country Rd. Mineola, New York 11501 Chmn, Board & Ch Exec Ofcr - C. R. Pierce			
New York State Elec & Gas Corp. 4500 Vestal Parkway East Binghamton, NY 13902 Chmn & Ch Exec Ofcr - C. F. Kennedy			
Niagara Mohawk Power Corp. 300 Erie Blvd W. Syracuse, New York 13202 Chmn, Board & Ch Exec Ofcr - J. G. Haehl, Jr.			
Orange & Rockland Utilities, Inc. One Blue Hill Plaza Pearl River, New York 10965 Chmn, Board & Ch Exec Ofcr - J. F. Smith			

	RESPONSE/DATED	PARTICIPATION	NON-PARTICIPATIC
Rochester Gas & Electric Corp. 89 East Avenue Rochester, New York 14649 Chmn, Board & Ch Exec Ofcr - P. W. Briggs			
NORTH CAROLINA			X
Carolina Powr & Light Co. Center Plaza Bldg. 411 Fayetteville St. Raleigh, North Carolina 27602 Chmn, Board Pres & Ch Exec Ofcr - S. J. Smith, Jr.	11-17-82		
Duke Power Company 422 South Church St. Charlotte, North Carolina 28242 Chmn, Board & Ch Exec Ofcr - Carl Horn, Jr.			
NORTH DAKOTA			X
Basin Electric Power Cooperative 1717 Insterstate Ave. Bismarck, North Dakota 58501 Gen Mgr - J. L. Grahl	12-3-82		
Montana-Dakota Utilities 400 North Fourth St. Bismarck, North Dakota Chmn, Board - D. M. Keskett	12-1-82	X	
United Power Association Stanton, North Dakota 58571 Plant Supt - M. Leer			
OHIO			
Cincinnati Gas & Electric Co. 139 East Fourth St. Cincinati, Ohio 45202 Pres & Ch Exec Ofcr - W. H. Dickhoner			

	RESPONSE/DATED	PARTICIPATION	NON- PARTICIPATI
Cleveland Electric Illuminating Co. 55 Public Square Cleveland, Ohio 44101 Pres & Ch Exec Ofcr - R. M. Ginn	11-15-82		X
Columbus & Southern Ohio Electric Co. 215 North Front Street Columbus, Ohio 43215 Chmn, Board & Ch Exec Ofcr - W. S. White, Jr.			
The Dayton Power & Light Company Courthouse Plaza Southwest Dayton, Ohio 45401 Pres & Ch Exec Ofcr - R. E. Frazer			
Ohio Edison Company 76 South Main St. Akron, Ohio 44308 Pres - J. T. Rogers, Jr.			
Pennsylvania Power Co. 1 E. Washington St. New Castle, PA 16103 Pres - A. Wayne Cole			
Toledo Edison Co. 300 Madison Ave. Toledo, Ohio 43652 Chmn, Board & Ch Exec Ofcr - J. P. Williamson			
Ohio Power Co. 301 Cleveland Ave., S.W. Canton, Ohio 44702 Chmn, Board & Ch Exec Ofcr -			
OKLAHOMA			
Oklahoma Gas & Electric Co. 321 No. Harvey Ave. Oklahoma City, Oklahoma 73101 Pres & Ch Exec Ofcr - J. G. Harlow, Jr.			

RESPONSE/DATED PARTICIPATION NON-PARTICIPATION

Pennsylvania Electric Co.
1001 Broad St.
Johnstown, PA 15907

Chairman, Board and Chief Executive Officer
W. G. Kuhns

West Penn Power Co.
Cabin Hill
Greensburg, PA 15601

Pres - L. S. Singley

RHODE ISLAND

The Narragansett Electric Co.
280 Melrose St.
Providence, RI 02901

Pres - E. E. Mulligan

SOUTH CAROLINA

South Carolina Electric & Gas Co.
328 Main St.
Box 764
Columbia, SC 29218

Pres & Chief Exec Officer - V. C. Summer

South Carolina Public Service Authority
223 N. Live Oak Drive
Moncks Corner, SC 29461

SOUTH DAKOTA

Northern States Power Co.
Sioux Falls Division
500 W. Russell
Sioux Fall, SD 57104

General Manager - D. D. Butterwick

	RESPONSE/DATED	PARTICIPATION	NON-PARTICIPATION
TENNESSEE			
Tennessee Valley Authority 400 Commerce Ave. Commercial Bldg. Knoxville, TN 37902			
TEXAS			
Austin Electric Dept. P.O. Box 1088 Austin, TX 78767 City Mgr - D. Davidson	11-19-82		X
Brazos Electric Power Cooperative Inc. 2404 LaSalle Ave. Box 6296 Waco, TX 76706 Exec V P & Gen Mgr - R. E. McCaskill	11-19-82		X
Central Power & Light Co. 120 N. Chaparral St. Corpus Christi, TX 78403 Pres & Chief Exec Officer - M. L. Borchelt			
Dallas Power & Light Co. 1506 Commerce St. Dallas, TX 75201 Pres & Chief Exec - J. S. Farrington	11-22-82		X
Denton Municipal Utilities 215 E. McKinney Denton, TX 76201 Dir, Util - R.E. Nelson			
El Paso Electric Co. P.O. Box 982 303 N. Oregon El Paso, TX 79960 Chmn Board Pres & Ch Exec Officer - Evern R. Wall			

	RESPONSE/DATED	PARTICIPATION	NON- PARTICIPATIC
Garland Power & Light System P.O. Box 401889 Garland, TX 75040 Dir Elect Util - R. C. Corder			
Houston Lighting & Power Co. P.O. Box 1700 Houston, TX 77001 Pres & Ch Exec Officer - D. D. Jordan			
Lower Colorado River Authority P.O. Box 220 Austin, TX 78767 Gen Mgr - C. Herring			
San Antonio City Public Service Board 145 Navarro Box 1771 San Antonio, TX 78296 Gen Mgr - J. K. Spruce	12-1-82		X
Southwestern Electric Power Co. E. Texas Div. P.O. Box 2312 Longview, TX 75601 VP, Div Mgr - E.J. Best			
Southwestern Public Service Co. SPS Tower 6th at Taylor P.O. Box 1261 Amarillo, TX 79170 Pres & Ch Exec Officer - Berl M. Springer			
Texas Electric Service Co. P.O. Box 970 Fort Worth, TX 76101 Pres & Ch Exec - W. G. Marquardt	11-22-82		X

Texas Power & Light Co.
1151 Bryan P.O. Box 226331
Dallas, TX 75201 Dallas, TX 75266

Pres & Ch Exec - R. K. Campbell

West Texas Utilities Co.
301 Cypress
Abilene, TX 79601

Pres & Ch Exec Officer - Glen D. Churchill

UTAH

Utah Power & Light Co.
1407 West North Temple St.
P.O. Box 899
Salt Lake City, UT 84110

Pres & Ch Exec Officer - H. Blundell

VIRGINIA

Virginia Electric & Power Co.
One James River Plaza
P.O. Box 26666
Richmond, VA 23261

Chm, Board & Ch Exec Officer

Appalachiam Power Co.
40 Franklin Rd, SW
Roanoke, VA 24011

Chmn, Board & Ch Exec Officer - W. S. White Jr.

WEST VIRGINIA

Monongahela Powe Co.
1310 Fairmont Ave.
Fairmont, WV 26554

Pres - D. E. Hollen

RESPONSE/DATED PARTICIPATION NON-PARTICIPATION

WISCONSIN

Dairyland Power Cooperative
2615 East Avenue South
La Crosse, WI 54601

Gen Mgr - F. Linder

Madison Gas & Electric Co.
100 N. Fairchild St.
Box 1231
Madison, WI 53701

Pres & Ch Exec Officer - D. J. Helfrecht

Wisconsin Electric Power Co.
231 W. Michigan St.
Box 2046
Milwaukee, WI 53201

Pres & Ch Exec Officer - C. S. McNeer

Wisconsin Power & Light Co.
222 W. Washington Ave.
Box 192
Madison, WI 53701

Pres & Ch Exec Officer - J. R. Underkofler

Wisconsin Public Service Corp.
700 N. Adams St.
Green Bay, WI 54301

Pres & Ch Exec Officer - Paul D. Zeimer

WYOMING

Utah Power & Light Co.
P.O. Box 191
Kennerer, WY 83101

Plant Mgr - L. Gordon

University of Wyoming

PUERTO RICO

Puerto Rico Water Resources Authority

Attachment 6

Mountain States Energy Inc.
POST OFFICE BOX 3662
BUTTE, MONTANA 59702
(406) 723-8182

November 8, 1982 82MSE-127

TO: All EEI Task Force

As discussed in the recent EEI MHD Task Force meeting at Palo Alto, Mountain States Energy, Inc. is undertaking a project funded by the State of Montana, Department of Natural Resources and Conservation (DNRC) to perform an Engineering Assessment of an MHD Advanced Test System (ATS). This is a follow-on activity to a DNRC funded Phase I program which established the overall performance requirements from a utility perspective. The Engineering Assessment (Phase II) will use these performance requirements to develop a system configuration, scoping cost, and schedule, for an ATS retrofit to an existing power plant. The overall objective of Phase II is to provide a utility concurred Engineering Assessment and recommendation to the National MHD Program for an MHD retrofit.

The first major task of the Phase II project is to select an existing State of Montana power plant to be used as the basis for the project. This selection will be the result of a process which encompasses a) the development of selection criteria, b) the solicitation of representative generic candidate plants from all utilities, and c) the selection by members of the Edison Electric Institute MHD Task Force of a Montana plant most representative of the national utility industry consensus.

6

Due to the budgetary constraints of the project, Mr. Heinz Pfeiffer was contacted on November 5, for recommendations of EEI Task Force members for the selection committee. From this conversation the following task force members were selected:

Dr. Manoj Guha	American Electric Power
D. L. (Bruce) Broussard	Arizona Public Service
Donald B. Blackman	Duke Power Company
Bob Urich	Florida Power & Light Company
Robert L. Bolger	Commonwealth Edison Company
J. W. Griswold	Southern California Edison
Larry McNair	Southern Company Services
Thomas J. McGrath	Puget Sound Power and Light
Clinton P. Ashworth	Pacific Gas & Electric Company

To obtain the selection (item c, above) it is planned to meet with this selection committee on Tuesday, December 7, 1982 in Denver, Colorado (meeting place to be determined).

Additional EEI Task Force involvement will be requested to input, review, and comment on various phases of the Engineering Assessment development (see Attachment I Project Milestone Schedule). This involvement will be further clarified at the Denver meeting.

Also included for your information is a copy of the letter sent to utilities with power generation facilities within the range required and a listing of the utilities invited to participate in this program.

MSE is therefore requesting your support in the above activities as an EEI Task Force participant. Total manpower provided by your company is estimated to be from 1 to 4 man months depending upon your desired level of participation in the program.

If you do not desire to be involved in this effort, let us know as promptly as possible. The performance and completion of the Phase II project will greatly enhance the National MHD Program and it's future direction. Therefore, it is hoped that your company can be counted on to support this project. Any questions, comments, or recommendations are solicited.

Your support of this project is greatly appreciated.

Sincerely,

J. M. Sherick
Vice President

JMS/pk

Attachment 7

EEI TASK FORCE

Dr. Manoj Guha
Staff Scientist
Advanced Energy Research Group
American Electric Power
Two Broadway
New York, New York 10004

Mr. D. L. Broussard
Vice President
Research and Development
Arizona Public Service
P.O. Box 2166
Phoenix, Arizona 85036

Mr. Harry D. Fletenstein, Jr.
President
Central Illinois Light Company
300 Liberty Street
Peoria, Illinois 61602

Mr. John Planck
Head Plant Engineer
Central Illinois Light Company
300 Liberty Street
Peoria, Illinois 61602

Mr. Robert L. Bolger
Commonwealth Edison Company
One First National Plaza
P.O. Box 767
Chicago, Illinois 60609

7

Mr. Gordon L. Heinz
Vice President
Consumers Power Company
1945 West Parnell Road
Jackson, Michigan 49201

Mr. R. E. Albrecht
Systems Operation
Consumers Power Company
1945 West Parnell Road
Jackson, Michigan 49201

Mr. Donald B. Blackman
Design Engineer
Duke Power Company
P.O. Box 33189
Charlotte, North Carolina 28242

Mr. Ned B. Spake
Vice President
Environmental and Technology
Florida Power Corporation
3201 34th Street South
St. Petersburg, Florida 33733

Mr. Bob Urick
Florida Power and Light Company
P.O. Box 529100
Miami, Florida 33152

Mr. Jim Turner
Research Director
Idaho Power Company
P.O. Box 70
Boise, Idaho 83707

Mr. Curt Stephine
Illinois Power Company
00 S. 27th Street
Decatur, Illinois 62525

Mr. Paul Zimmer
irector, Research and Resource Planning
llinois Power Company
500 S. 27th Street
ecatur, Illinois 62525

. Rand Thurgood
Manager, Fossil Fuel Development
Utah Power and Light Company
O. Box 899
lt Lake City, Utah 84110

Dr. Fred E. Walter
The Montana Power Company
40 East Broadway
Butte, Montana 59701

Mr. Sidney H. Law
Director of Research
The Northeast Utilities Service Company
Box 270
Hartford, Connecticut 06101

Mr. Clinton P. Ashworth
Supervising Mechanical Engineer
Pacific Gas and Electric Company
77 Beale Street
San Francisco, California 94106

Mr. Heinz G. Pfeiffer
Manager
Technology and Energy Assessment
Pennsylvania Power and Light
Two North Ninth Street
Allentown, Pennsylvania 18101

r. John P. Gibbons
ngineer-In-Charge
Energy Conservation Research Section
Philadelphia Electric Company
301 Market Street 510-1
Philadelphia, Pennsylvania 19101

r. Peter Schaub
anager, New Technology Programs
otomac Electric Power Company
homas Edison Building
900 Pennsylvania Avenue, NW
ashington, D.C. 20068

Mr. Jack Groves
Public Service Company of New Mexico
P.O. Box 2267
Albuquerque, New Mexico 87103

Mr. Thomas J. McGrath
Director, Generating Plant Engineering
Puget Sound Power and Light
Puget Sound Building
Bellevue, Washington 98009

Dr. James W. Moyer
Southern California Edison
2244 Walnut Grove Avenue
Rosemead, California 91770

Mr. J. W. Griswold
Southern California Edison
2244 Walnut Grove Avenue
Rosemead, California 91770

Mr. Larry McNair
Southern Company Services
P.O. Box 2625
Birmingham, Alabama 35202

Mr. W. C. Spencer
Vice President
Virginia Electric and Power
P.O. Box 564
Richmond, Virginia 23261

Mr. Robert T. Combs
Power Station Engineering and Construction
Virginia Electric and Power
P.O. Box 564
Richmond, Virginia 23261

Mr. Michael A. Trykoski
Edison Electric Institute
1111 19th Street, NW
Washington, D.C. 20036

Dr. R. Balzhiser
Electric Power Research Institute
3412 Hillview Avenue
Palo Alto, California 94304

Mr. Graham R. Siegel
Tennessee Valley Authority
1360 Commerce Union Building
Chatanooga, Tennessee 37401

Mountain States Energy Inc.
POST OFFICE BOX 3767
BUTTE, MONTANA 59701
(406) 494-7100
FTS 587-7100

Date: December 13, 1982

To: J. M. Sherick

Thru:

Copies: G. Nelson, B. Hiers, N. Egan

From: G. Ashby

Subject: Trip Report - Engineering Assessment

On December 7, 1982, a meeting was held in Denver, Colorado with representatives of the EEI MHD Task Force. The purpose of this meeting was to obtain their concurrence of the Montana Power Company's J. E. Corette plant as the plant to be used for the Engineering Assessment of an MHD retrofit to serve as an Advanced MHD Test System.

Mr. Walter of the Montana Power Company agreed to replace Mr. Griswold of Southern California Edison, who could not attend the meeting. Mr. Bolger of Commonwealth Edison Company had to cancel his plans, on December 6, for attending the meeting. A replacement could not be obtained due to the time constraint imposed by this late cancellation.

The only concern expressed by the Task Force with respect to the Engineering Assessment was that the cost of the retrofit would probably be more than what would be available if the retrofit becomes a reality.

All members present at the meeting extended their appreciation to the State of Montana for sponsoring the Engineering Assessment and promotion of the MHD Technology Development.

The agenda used for this meeting and the plant concurrence received are attached.

8

EWA/klm

The undersigned members of the EEI MHD Task Force have reviewed the following candidate plants submitted for consideration as an MHD retrofit Advanced Test System.

1.	Sheldon Station	109 MW_e	Nebraska Public Power District
2.	J. E. Corette	160 MW_e	Montana Power Company
3.	Frank Bird	60 MW_e	Montana Power Company
4.	Canady Plant	100 MW_e	Central Nebraska Public Power and Irrigation District
5.	Lewis and Clark Station	50 MW_e	Montana-Dakota Utilities
6.	George Neal Station Unit #1	139 MW_e	Iowa Public Service Co.

These plants all basically comply with the criteria imposed for candidate submittal. Consequently any of these plants could ultimately serve as a valid Advanced Test System. However, the larger of these plants, which are the majority, have steam conditions, reheat, etc., more nearly consistent with presently projected Heat-Seed Recovery Systems. Therefore, an Advanced Test System developed around these type plants would be more directly scaleable to the first-generation commercial MHD plant.

Although we believe any of the Montana plants would provide the basis for a valid representation of the submitted candidates, we believe the essential features of these candidates are best represented by the Montana Power Company's J. E. Corette plant in Billings, Montana.

We therefore concur with Mountain States Energy's recommendation that the J. E. Corette plant be chosen for the Engineering Assessment of an MHD retrofit to serve as an Advanced Test System.

Clinton P. Ashworth

Clinton P. Ashworth
Pacific Gas and Electric Co.

Al Dolbec
Electric Power Research Institute

Fred E. Walter

Fred E. Walter
Montana Power Co.

Robert L. Bolger
Commonwealth Edison Co.

MEETING AGENDA, December 7, 1982

E.E.I. Task Force on MHD
EPRI
Mountain States Energy, Inc.

1. DNRC Project Status
    - Project Objectives
    - Activity to Date
    - Retrofit Candidates Submitted to Date

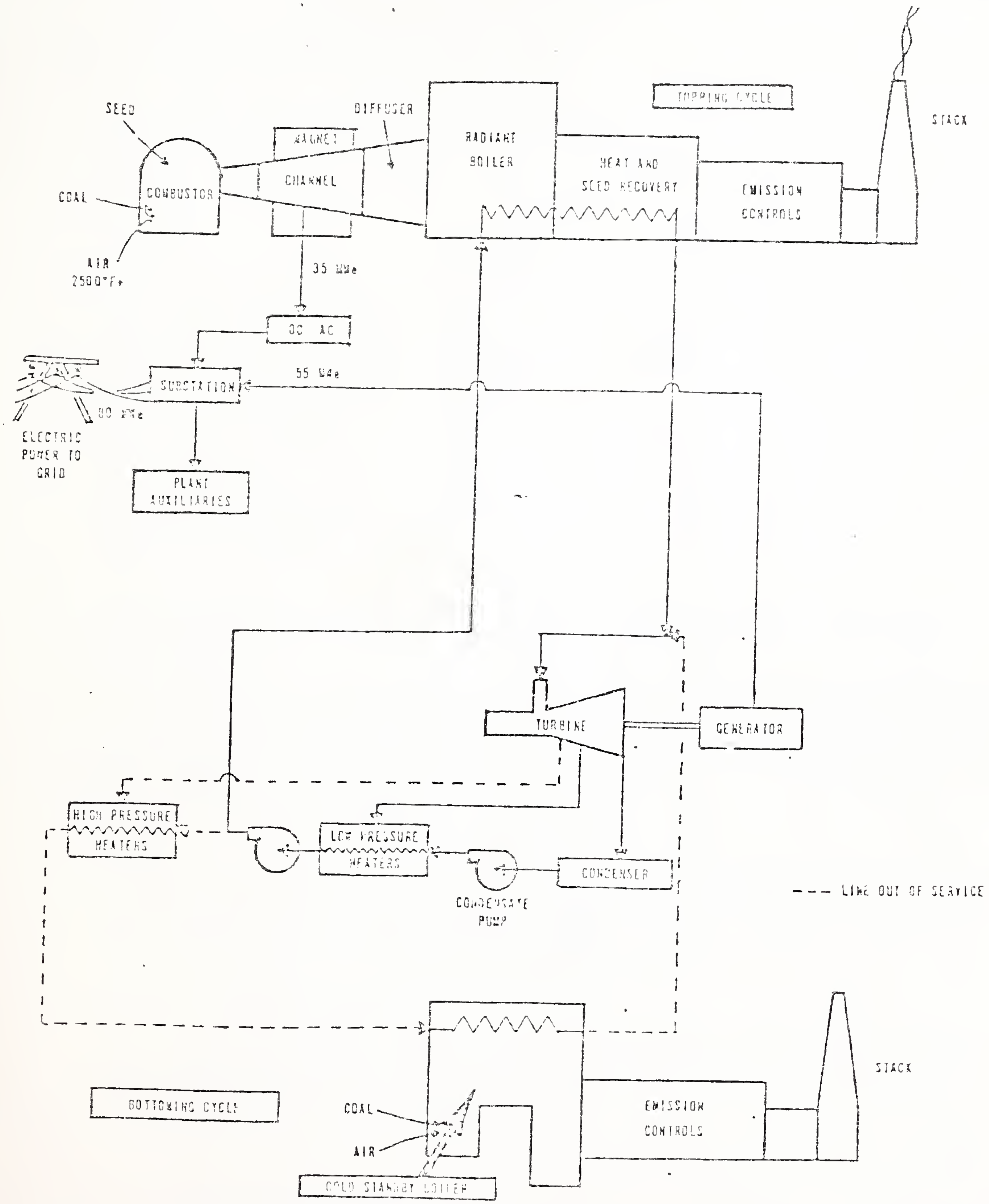
2. Selection Criteria
    - Plant Size
    - Similarity to Other Retrofit Candidates
    - MHD Interface to Steam Plant
    - Impact on Plant Availability

3. Retrofit Plant Selection

Name of Plant	Lewis & Clark	Frank Bird	J. E. Corette	Sheldon Unit #2	Canaday	Geo. Neal Unit #1
Location	Sidney, MT	Billings, MT	Billings, MT	Hallam, NE	Lexington, NE	Sioux City, IA
Utility Company	MDU	MPC	MPC	NPPD	CHPP & ID	Iowa Pub. Svc. Co.
Power Output, MW_e (net, max)	51	66	163	123	96	132
Fuel	Lignite	#2 Fuel Oil	Rosebud Coal	Sub-bit. Coal	#6 Fuel Oil	Coal or Nat. Gas
Thermal Input, (10^8 BTU/Hr.)	5.75	7.71	16.34	12.5	9.00	12.5
Plant Heat Rate, BTU/KW-Hr.	11270	11840	9843	10160	9375	9470
Overall Efficiency, pct	30.3	28.8	34.8	33.6	34.6	36.0
Turbine:						
Number of Stages	16	20	22	20	23	21
Feedwater Heaters	5	4	6	5	5	6
Turbine Reheat	NO	NO	YES	YES	YES	YES
Inlet Steam Flow, lbm/hr	475,000	590,000	1.23×10^6	830,000	651,000	948,600
Inlet Steam Pressure, psia	1264	863	1903	1864	1814	1815
Inlet Steam Temperature, deg. F	950	900	1000	1000	1000	1000
Inlet Steam Enthalpy, BTU/lbm	1468	1453	1478	1479	1480	1480

DATA SUMMARY OF RETROFIT CANDIDATES

SCHEMATIC OF 70 MWe
CLASS RETROFIT INTEGRATION



RETROFIT DESIGN OPTIONS

1. Gas or Steam Tie-in to Existing Plant

   - Steam tie-in is preferable for first retrofit. Gas tie-in has higher risk due to slag/seed fouling and corrosion of existing boiler.

2. MHD/Steam Plant Interface (Heat Recovery Unit)

   - For smaller plants (up to about 100 MW_e) the MHD side can be sized by requiring that the exhaust heat from the MHD cycle be sufficient to supply all of the steam required to power the turbine.

   - For larger plants the required scale-up of the MHD side is too great to permit full turbine powering by exhaust heat alone. Therefore, either the turbine must be operated at below rated capacity or the existing boiler must be partially but continuously fired. This complicates both the interfacing as well as the control problems, but both of these problems are manageable.

   - An alternate interfacing scheme, that of a combustion gas tie-in to the steam plant, has been considered but is probably of somewhat higher risk.

3. Steam Generation from MHD Side

   - Balanced Turbine Powering -

     MHD topping cycle is sized so as to supply sufficient steam generation to power the existing turbine. This concept is workable for turbine sizes smaller than about 100 MW_e. Above that size, scale-up uncertainties result in considerably greater risk.

   - Partial Turbine Powering -

     This scheme is possible for larger size turbines, but existing boiler must then be used continuously or else the turbine must be operated below design capacity (turndown mode).

4. Oxygen Enrichment/Air Preheat

   - Recent NASA studies suggest that some degree of O_2 enrichment coupled with low-temperature air preheaters offer a reasonably efficient retrofit design, with minimal risk and cost of electricity.

- Tradeoffs exist between compressor work required for O_2 plant, and air compressor, and possible reduced magnet costs (4.5T vs. 6.0T with no enrichment).
- Directly-fired recuperative air preheaters with low to intermediate preheat temperature (below 1800°F) preferred over regenerative separately-fired.

5. Combustor

- Two-stage burning will minimize NO_x formation.
- Sizing Criteria: Must supply sufficient enthalpy for air preheaters, steam generation, and MHD power generation.
- Heat Losses: 4-5% for reasonable overall efficiency.

6. MHD Generator

- Enthalpy Extraction in the range of 12-15%.
- Supersonic generator offers possibility of lower cost magnet (lower peak B-field).
- Two-terminal (diagonal) connection would simplify the power consolidation problem.

7. Superconducting Magnet

- Cost can be reduced considerably by using lowest possible peak field compatible with enthalpy extraction considerations. Should be possible to design a reasonably efficient retrofit with B_{pk} = 4.5 T if a supersonic channel and O_2 enrichment are used.

8. HRSR Unit

- Low slag carryover from combustor (∿ 10%) is desirable to reduce fouling problems.
- Sufficiently long residence time (2-3 sec) to reduce NO_x to acceptable levels.
- Heat recovery through boiler section must be reasonably efficient (80-85%).

Attachment 9

Mountain States Energy Inc.
POST OFFICE BOX 3662
BUTTE, MONTANA 59702
(406) 723-8182

INVOICE

Date: December 15, 1982
Contract: DNRC Milestone I
Invoice No.: DNRC-01

Department of Natural Resources
32 South Ewing
Helena, MT 59620

Direct Labor	$10,734.50	
Fringe	4,482.39	
		$15,216.89
Overhead		6,605.53
Other Direct:		
Travel	$ 1,636.38	
Computer Support	150.00	
Consultants	3,000.00	
		$ 4,786.38
General & Administrative		5,461.64
TOTAL COSTS		$32,070.44
Fee		$ 5,062.50
TOTAL INVOICE		$37,132.94

9

Frank C. Fogarty

Frank C. Fogarty, President

Attachment 10

ESTIMATED COSTS

MILESTONE #2

Direct Labor	$10,386.63	
Fringe	$ 4,329.03	$14,715.66
Labor Overhead		$ 6,297.74
Other Direct Cost		
Consultants	$ 3,850.00	
Travel	$ 1,000.00	
Computer Support	$ 2,000.00	
Reproduction	-0-	
Materials & Supplies	$ 200.00	$ 7,050.00
Direct Costs		$28,063.40
General & Administrative		$ 5,777.76
Cost		$33,841.16
Fee		$ 5,062.50
Price		$38,903.56

EXHIBIT B

PAGE OF

MILESTONE SCHEDULE AND STATUS REPORT

1. Contract Identification Department of Natural Resources and Conservation

2. Reporting Period through

3. Contract Number

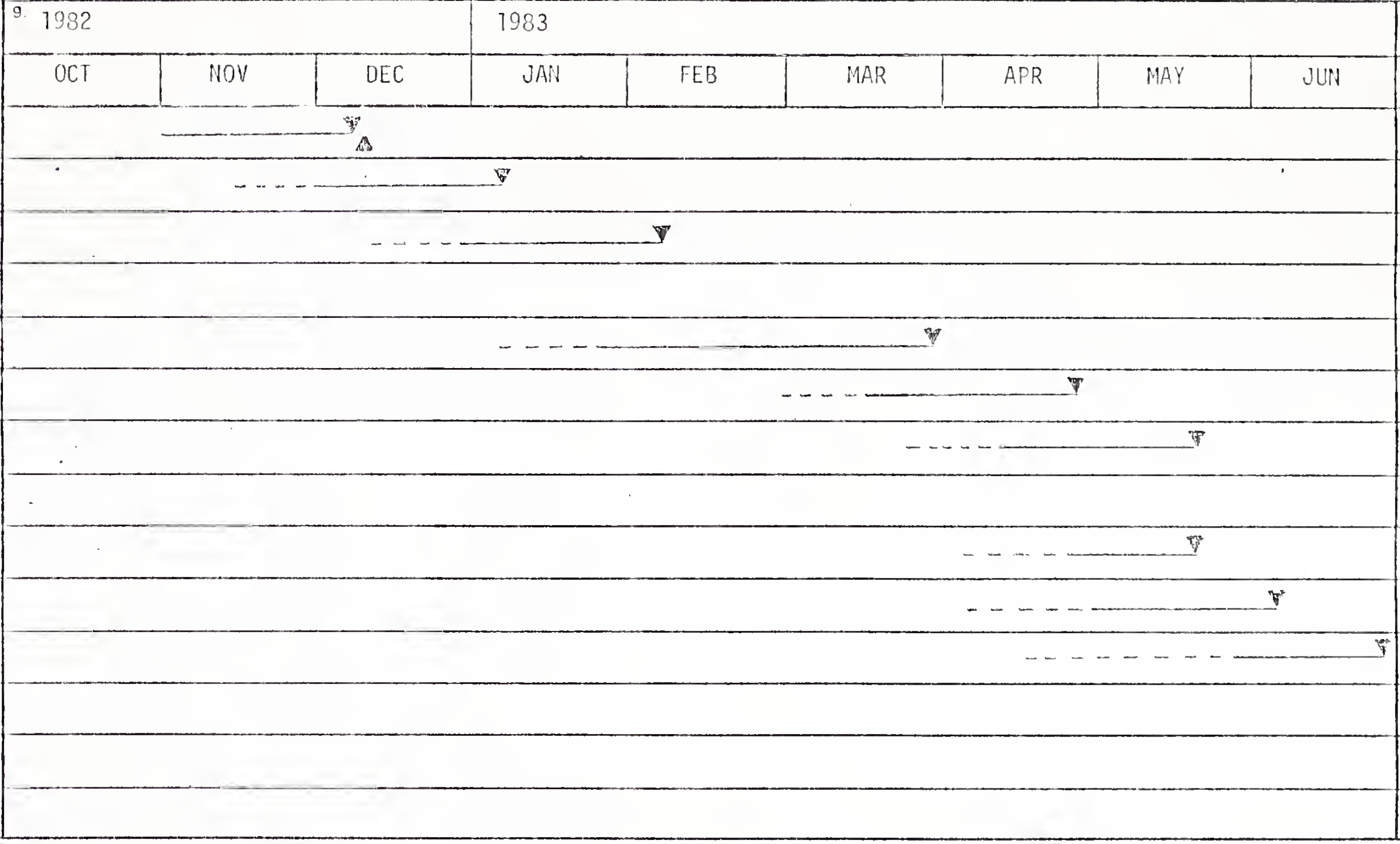
4. Contractor (name, address) Mountain States Energy, Inc.
P. O. Box 3767
Butte, MT 59702

5. Contract Start Date November 1, 1982

6. Contract Completion Date June 29, 1983

7. Identification Number	8. Reporting Category (e.g., contract line item or work breakdown structure element)	10. Percent Complete a) Planned	b) Actual
DNRA	DETERMINATION OF PLANT TO BE USED FOR RETROFIT		
DNRB	SPECIFICATION OF BASELINE CONFIGURATION		
DNRC	CONFIGURATION ANALYSIS		
DNRD	DETERMINE DESIGN REQMTS		
DNRE	REVISION OF DESIGN REQUIREMENTS		
DNRF	COST AND SCHEDULE ESTIMATES		
DNRG	IMPACT ON NATIONAL MHD DEVELOPMENT PROGRAM		
DNRH	DRAFT ENGINEERING ASSESSMENT		
DNRI	ISSUE ENGINEERING ASSESSMENT		

9.



11. Remarks

12. Signature of Contractor's Project Manager and Date

Attachment 11

KEY MILESTONE LIST

	IDENT NUMBER	DESCRIPTION	SCHEDULED START	ACTUAL START	SCHEDULED COMPLETION	ACTUAL COMPLETION
1.	DNRA	DETERMINATION OF PLANT TO BE USED FOR RETROFIT SC - INITIATION OF CONTRACT WORK AS AUTHORIZED BY THE DEPT. CC - OBTAIN EEI CONCURRENCE AND SELECTION OF CANDIDATE MONTANA PLANT	11-01-82	11-01-82	12-07-82	12-10-82
2.	DNRB	SPECIFICATION OF BASELINE CONFIGURATION SC - SUCCESSFUL COMPLETION OF MILESTONE 1 AS INDICATED BY DEPARTMENT APPROVAL CC - THE ISSUANCE OF PRELIMINARY BASELINE SPECIFICATION TO BE USED FOR FOLLOW ON WORK	12-01-82	12-13-82	01-06-83	
3.	DNRC	CONFIGURATION ANALYSIS SC - SUCCESSFUL COMPLETION OF MILESTONE 2 CC - THE ISSUANCE OF A PLANT CONFIGURATION TO BE USED FOR FOLLOW ON WORK	12-29-82		02-09-83	
4.	DNRD	DETERMINE DESIGN REQUIREMENTS SC - SUCCESSFUL COMPLETION OF MILESTONE 3 CC - ISSUANCE OF A DRAFT DESIGN REQUIREMENTS TO TEN UTILITIES FOR CONCURRENCE	01-27-83		03-30-83	
5.	DNRE	FINALIZATION OF DESIGN REQUIREMENTS SC - SUCCESSFUL COMPLETION OF MILESTONE 4 CC - OBTAIN UTILITY CONCURRENCE	03-14-83		04-26-83	
6.	DNRF	COST AND SCHEDULE ESTIMATES SC - SUCCESSFUL COMPLETION OF MILESTONE 5 CC - ESTIMATED COST OF MHD RETROFIT AND SCHEDULE FOR RETROFIT ACCOMMODATION	04-11-83		05-17-83	
7.	DNRG	IMPACT ON NATIONAL MHD DEVELOPMENT PROGRAM SC - COMPLETE MILESTONE 5 OR APPROVED BY THE DEPARTMENT CC - RECOMMENDATION TO THE NATIONAL MHD PROGRAM	04-18-83		05-17-83	

KEY MILESTONE LIST

	IDENT NUMBER	DESCRIPTION	SCHEDULED START	ACTUAL START	SCHEDULED COMPLETION	ACTUAL COMPLETION
8.	DNRH	DRAFT ENGINEERING ASSESSMENT SC - COMPLETE MILESTONES 6 & 7 CC - ISSUE DRAFT ENGINEERING ASSESSMENT	05-02-83		06-07-83	
9.	DNRI	FINALIZE ENGINEERING ASSESSMENT SC - COMPLETE MILESTONE 8 CC - ISSUE FINAL ENGINEERING ASSESSMENT	05-25-83		06-29-83	